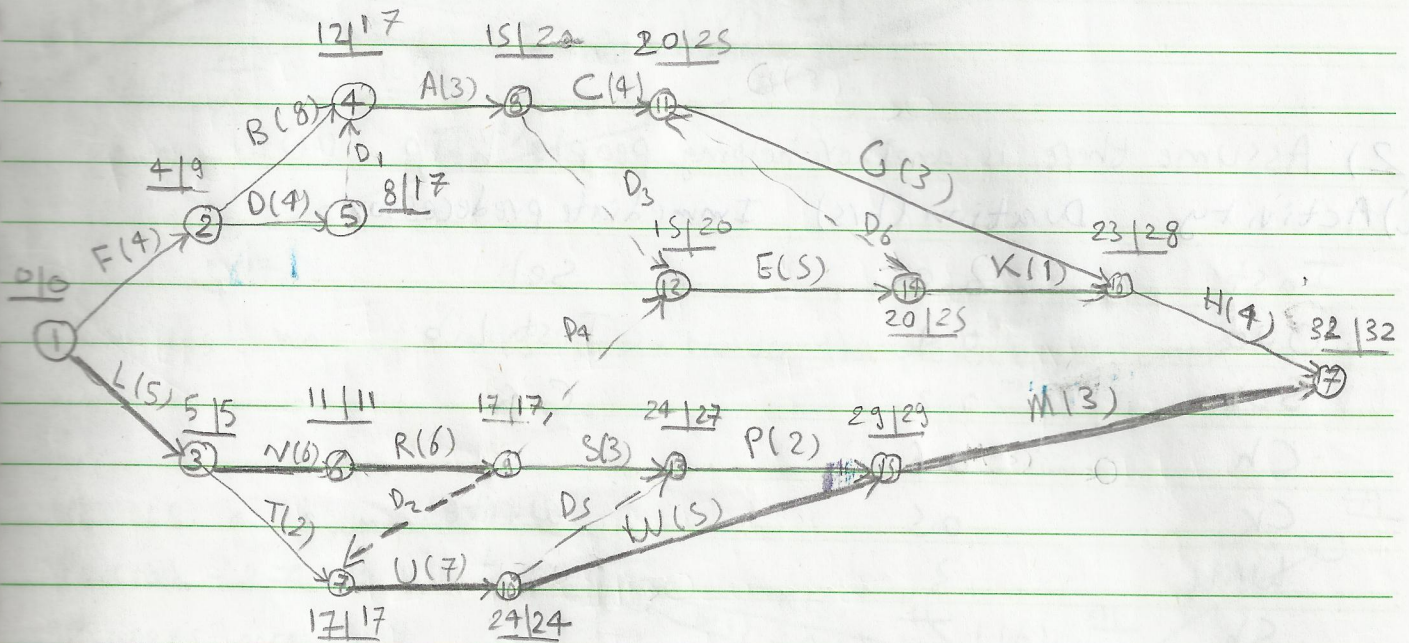


Assignment (1)



Total completion time = 32 days, critical path:

Activity Duration(days) ES LS EF LF FF

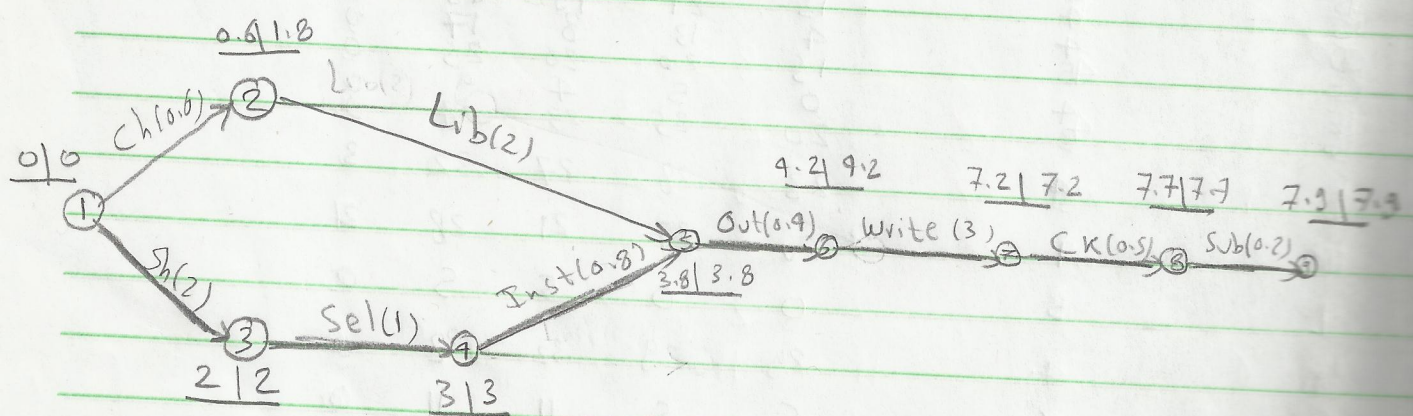
A	3	12	17	15	20	0
B	8	4	9	12	17	0
C	4	15	21	19	25	3
D	4	4	13	8	17	0
E	5	15	20	20	25	0
F	4	0	5	4	9	0
G	3	20	25	23	28	0
H	4	23	28	27	32	3
K	1	20	27	21	28	2
L	5	0	0	5	5	0
M	3	29	29	32	32	0
N	6	5	5	11	11	0
P	2	24	27	26	29	3
R	6	11	11	17	17	0
S	3	17	24	20	27	4
T	2	5	5	7	17	10
U	7	17	17	24	24	0
W	5	24	24	29	29	0
X	8	17	17	8	17	4
Y	17	17	17	17	17	0
Z	15	20	15	20	20	0
AA	17	20	17	20	20	0
AB	24	24	24	24	24	0
AC	25	25	25	25	25	0

(i) Activities could be delayed without delaying the early start of the following activities: C, H, K, P, S, T, D₁ & D₂

2) Assume there is another helping people help

Activity	Duration (hrs)	Immediate predecessor
Inst	0.8	Sel
Out	0.4	Inst, Lib
Sub	0.2	CK
Ch	0.6	CK
CK	0.5	Write
Write	3	Out
Sh	2	
Sel	1	Sh
Lib	2	Ch

(ii)

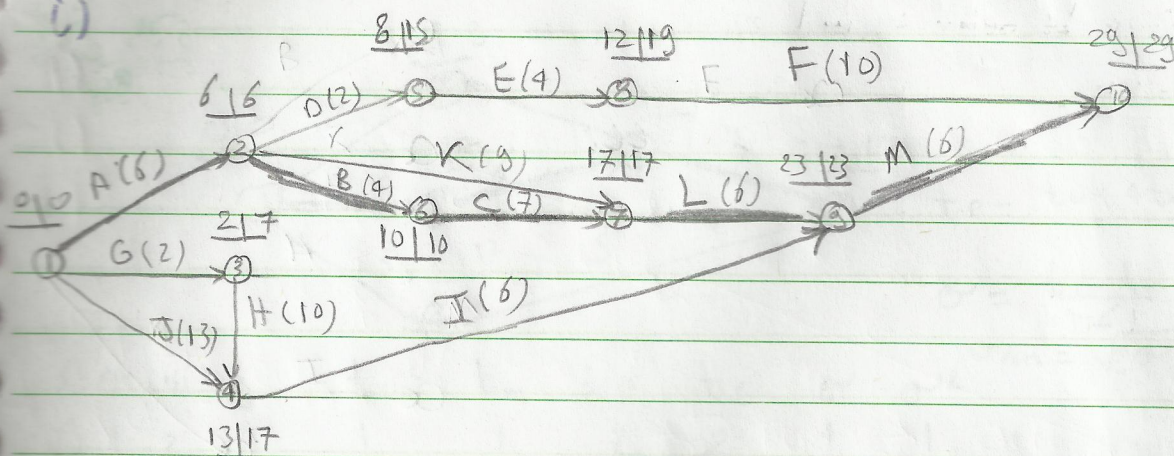


Critical path: Sh - Sel - Inst - Out - Write - CK - Sub
 Expected duration time - 7.9 hrs

- (iii) 1- Expected times aren't real especially activities on critical path
 2- Some activities can be mutually exclusive

3)

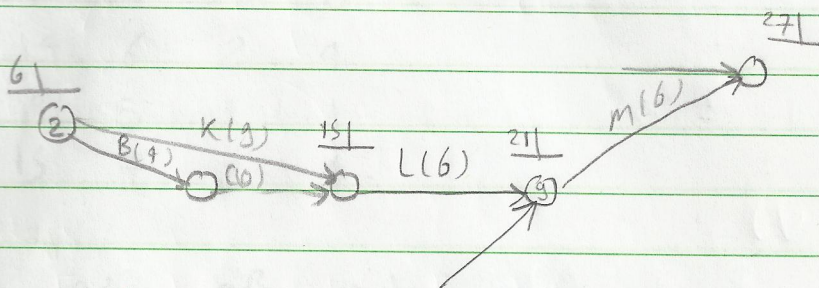
i)



Earliest no. of weeks to introduce the product = 29 week

ii)

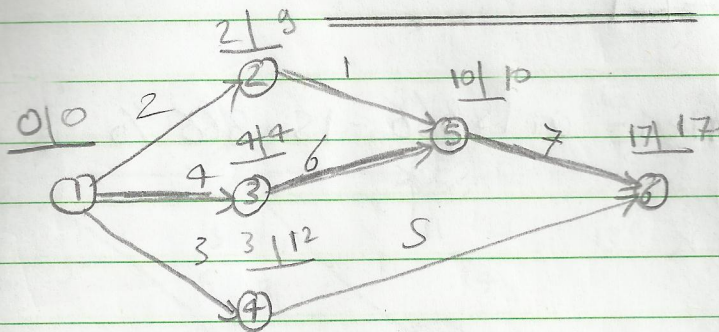
c) is a dummy
Period = 27 week
2 weeks are saved



iii) $FF_D = 8 - 6 - 2 = 0$ delay to not delay next activity (E)
 $TF_D = 15 - 6 - 2 = 7$ delay to not delay the project

Time = $\min(FF_D, TF_D) = 0$

Assignment(2)



$$t_e = \frac{t_o + 4t_m + t_p}{6}$$

$$\sigma = \frac{t_p - t_o}{6}$$

$$\sigma_{path} = \sqrt{\sum_{i=1}^n \sigma_i^2}$$

Activity	t_o	t_m	t_p	t_e	σ	σ^2
1-2	1	1	7	2	1	1
1-3	1	4	7	4	1	1
1-4	2	2	8	3	1	1
2-5	1	1	1	1	0	0
3-5	2	5	14	6	2	4
4-6	2	5	8	5	1	1
5-6	3	6	15	7	2	4

Path	t_e	$t_{e_{acc}}$	σ^2	σ_{acc}^2	σ
1-2	2		1		
2-5	1	10	0	5	$\sqrt{5}$
5-6	7		4		
1-3	7		1		
3-5	14	17	4	9	3
5-6	15		4		
1-4	8	8	16		
4-6	8		1	2	$\sqrt{2}$

i) Expected completion time = 17 week

$$i) \bar{x} = 17 - 3 = 14 \text{ week}$$

$$z = \frac{x - \bar{x} - 14 - 17}{3} = -1$$

$$P(z \leq -1) = 0.5 - 0.34134 = 0.15866 = 15.866\%$$

$$ii) x = 17 + 3 = 20 \text{ week}$$

$$z = \frac{20 - 17}{3} = 1$$

$$P(z \geq 1) = P(z \leq -1) = 0.15866$$

$$iv) x = 18$$

$$z = \frac{18 - 17}{3} = 0.33$$

$$P(z \geq 0.33) = 0.5 - 0.12930 = 0.3703 = 37.03\%$$

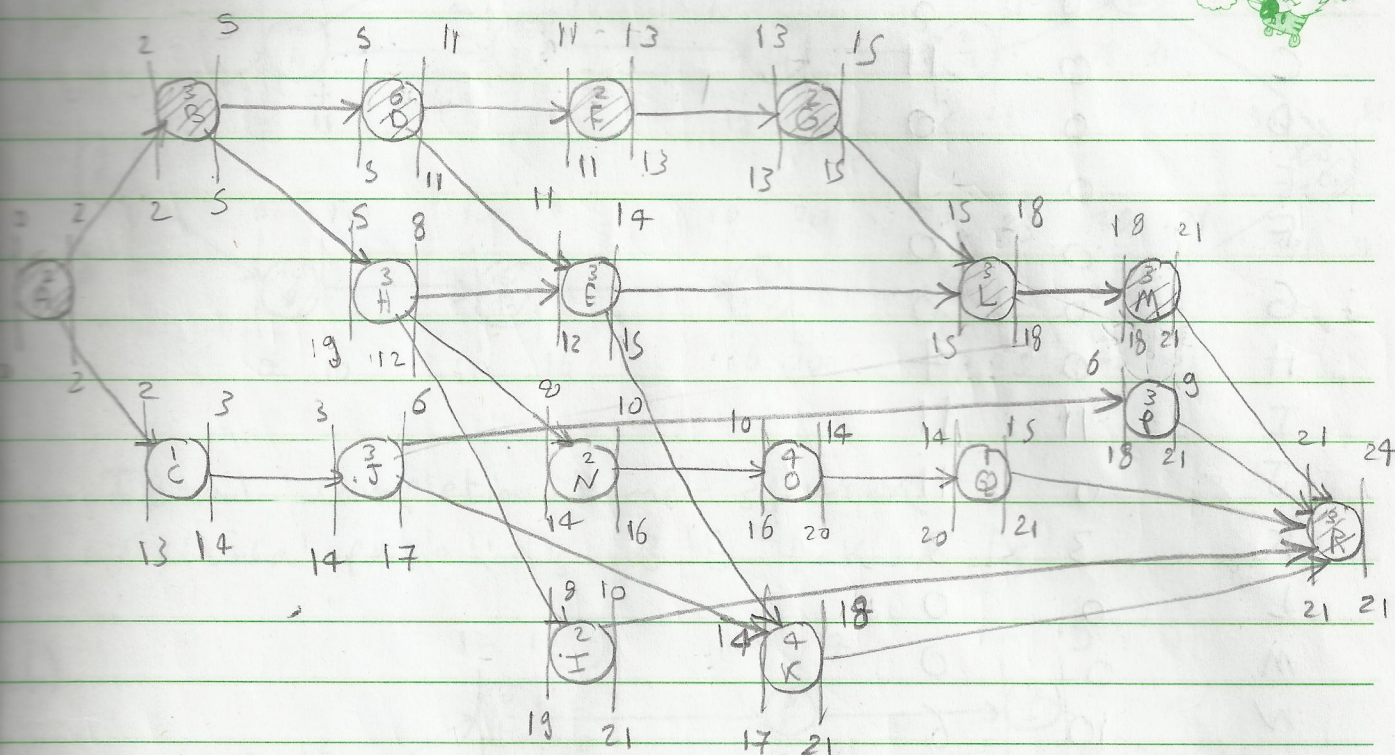
v)

$$P(z \leq A) = 0.9 = 0.5 + P(0 \leq z \leq A)$$

$$P(0 \leq z \leq A) = 0.4$$

$$A = 1.28 = \frac{x - 17}{3}$$

$$x = 20.84 \text{ weeks} = 20 \text{ weeks}$$



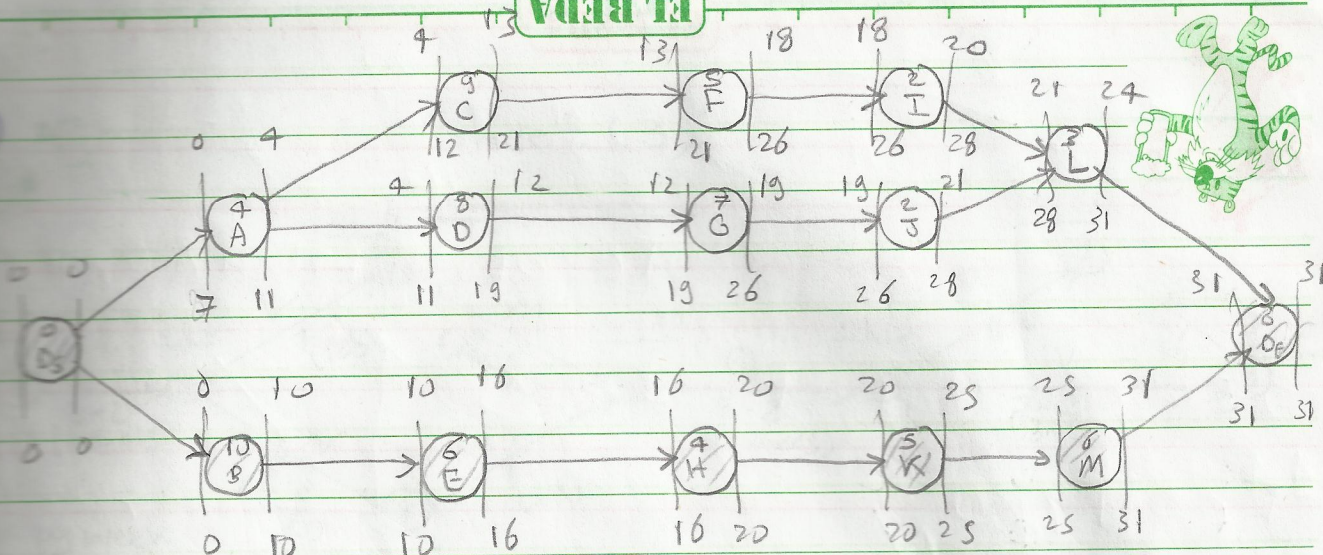
Total completion time = 24 day

Critical path: A-B-D-F-G-L-M-R

Link	LAG	Link	LAG	Link	LAG
A-B	0	J-P	0	L-M	0
A-C	0	J-K	8	Q-R	6
B-D	0	F-G	0	M-R	0
B-H	0	E-L	1	P-R	12
C-J	0	E-K	0		
D-F	0	N-O	10		
D-E	0	I-R	11		
H-E	3	G-L	0		
H-N	0	O-Q	0		
H-I	0	K-R	3		

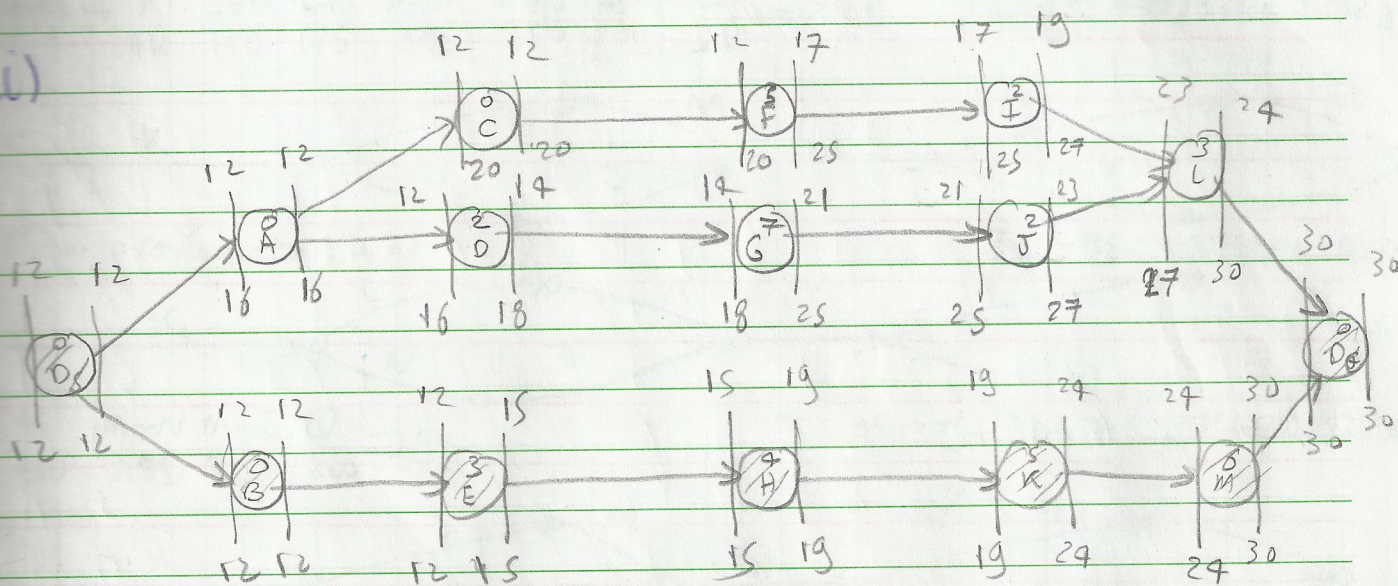
Activity	FF	TF
A	0	0
B	0	0
C	0	11
D	0	0
E	0	1
F	0	0
G	0	0
H	0	4
I	11	11
J	0	11
K	3	3
L	0	0
M	0	0
N	10	6
O	0	6
P	12	12
Q	6	6
R	0	0

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Total completion time = 31 weeks

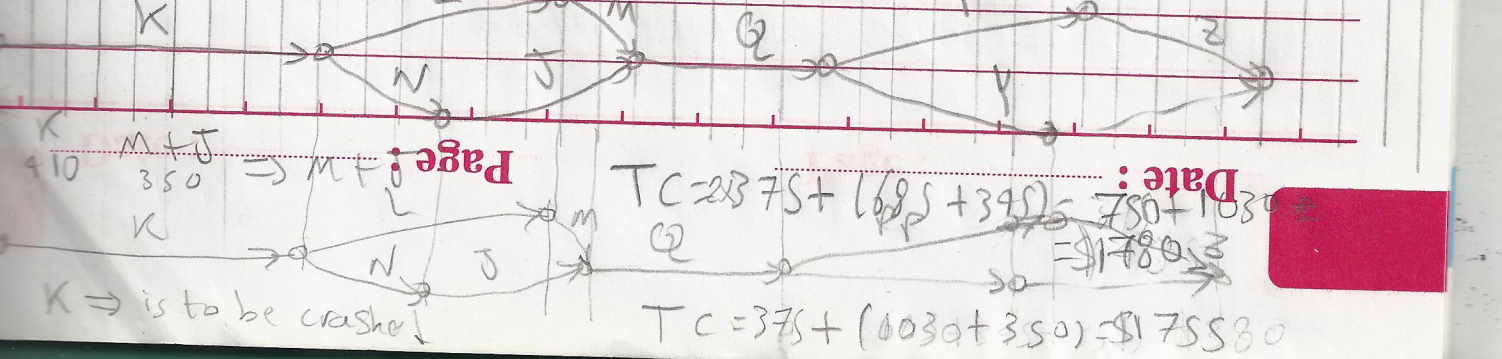
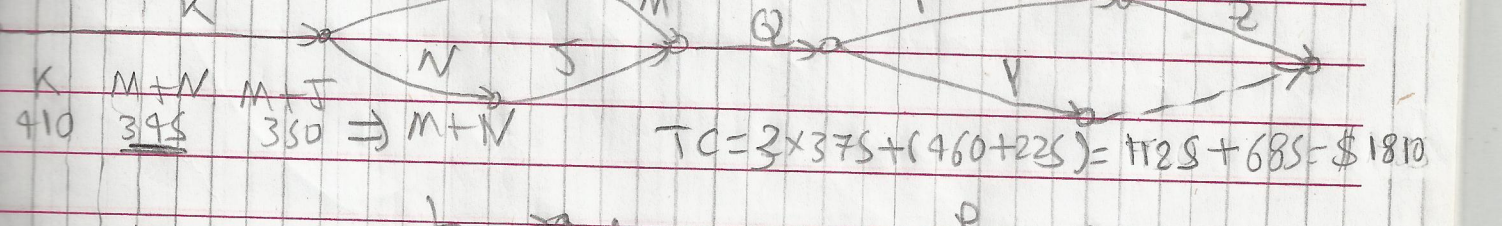
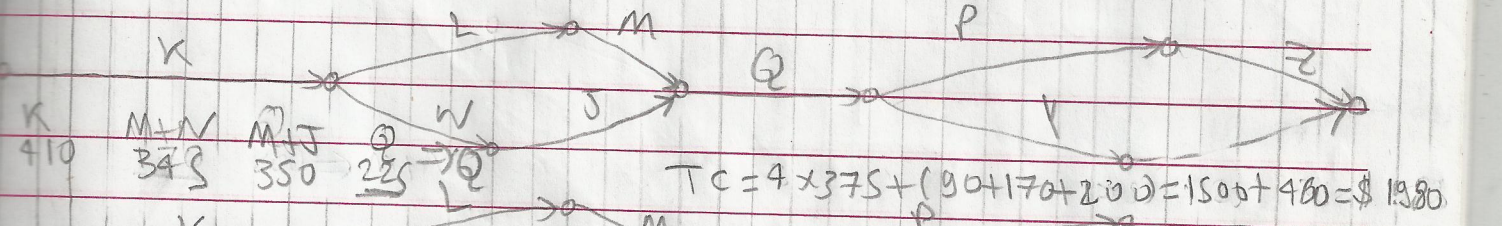
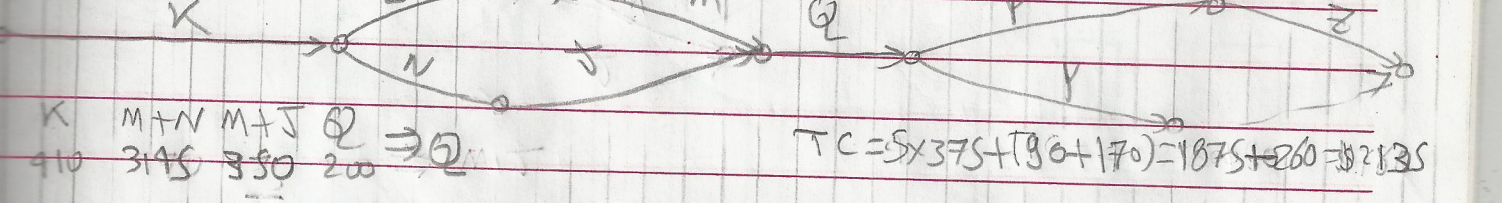
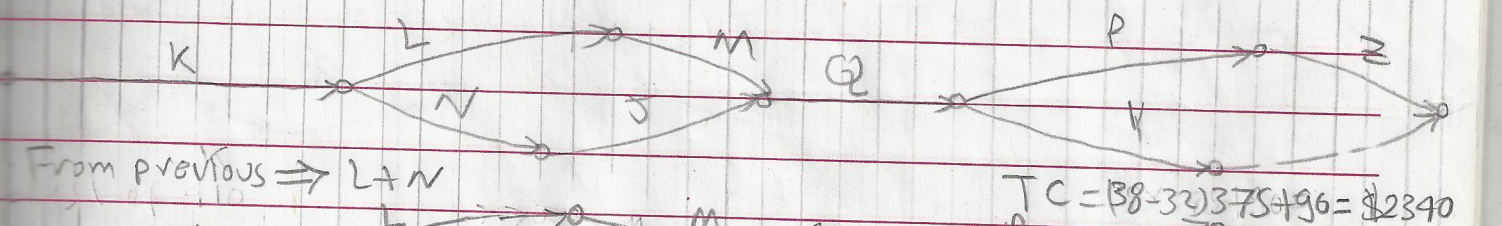
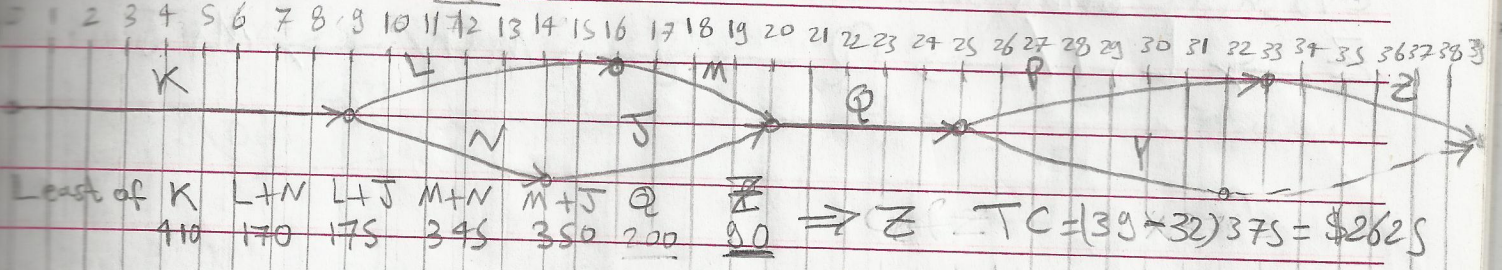
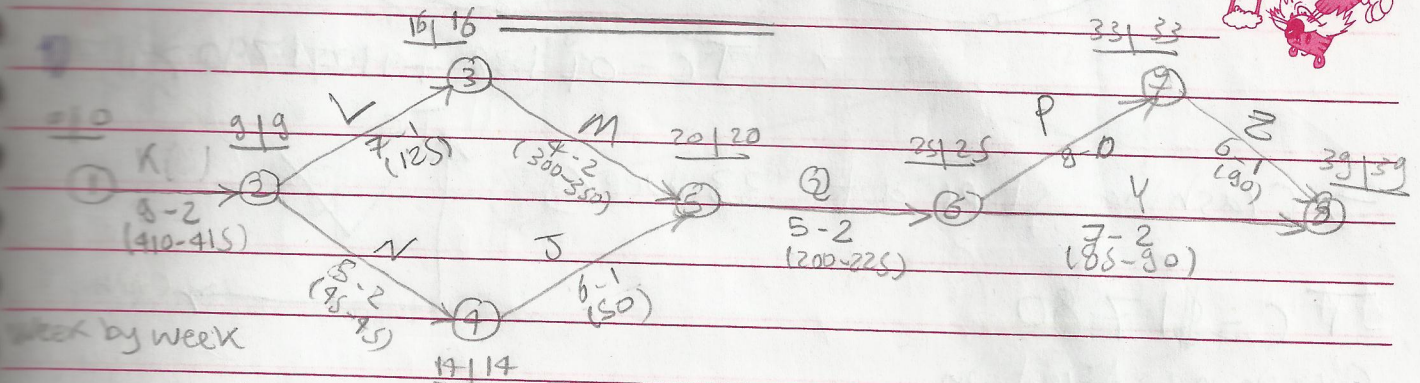
Critical path: Ds - B - E - H - K - M - Ds

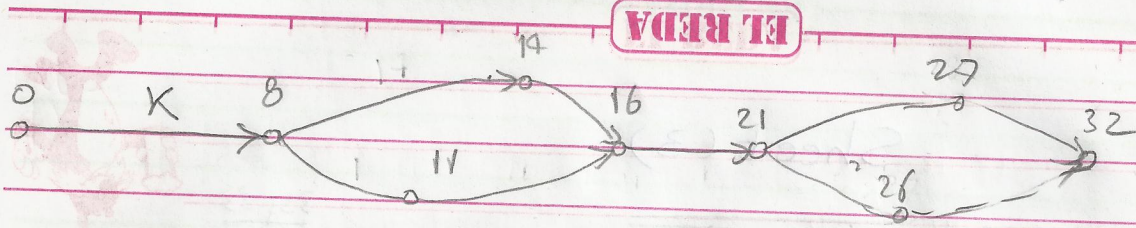


Total completion time = 30 weeks

Critical path: Ds - B - E - H - K - M - Ds

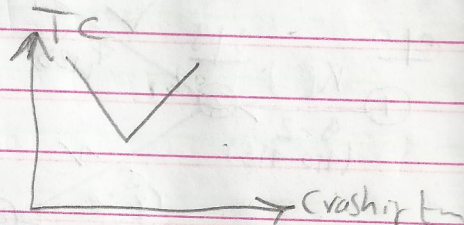
Sheet (3)





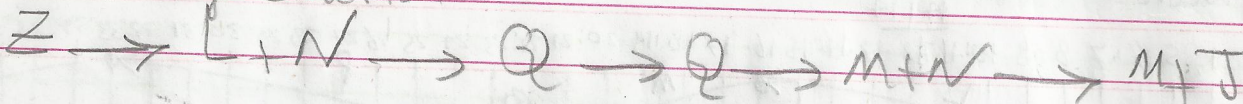
$$TC = 0 + 1380 + 910 = \$1790 > \$1780$$

→ Crashing stops at 33 weeks



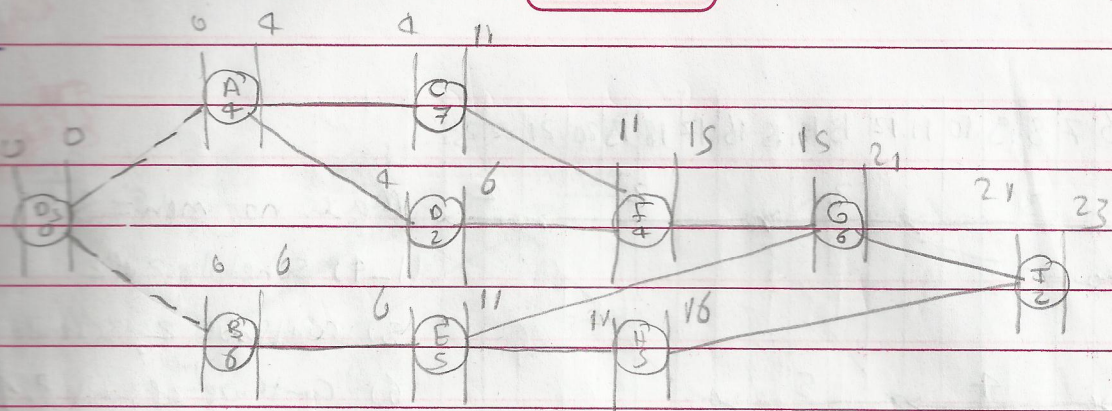
$$TC = \$1780$$

Crashing direction

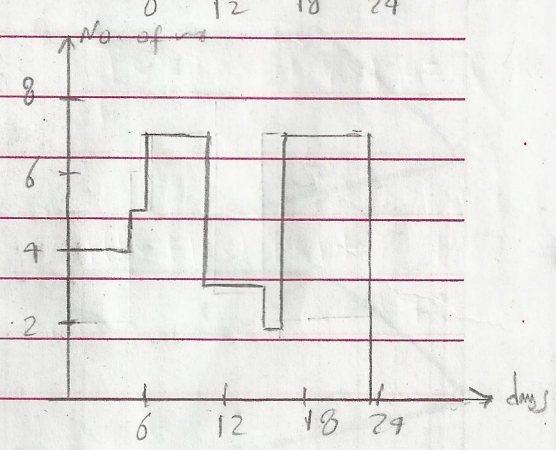
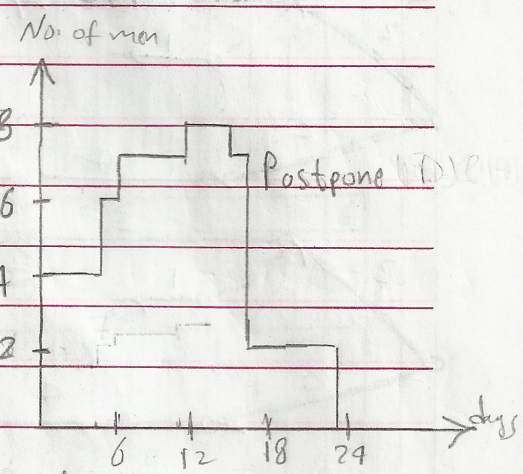
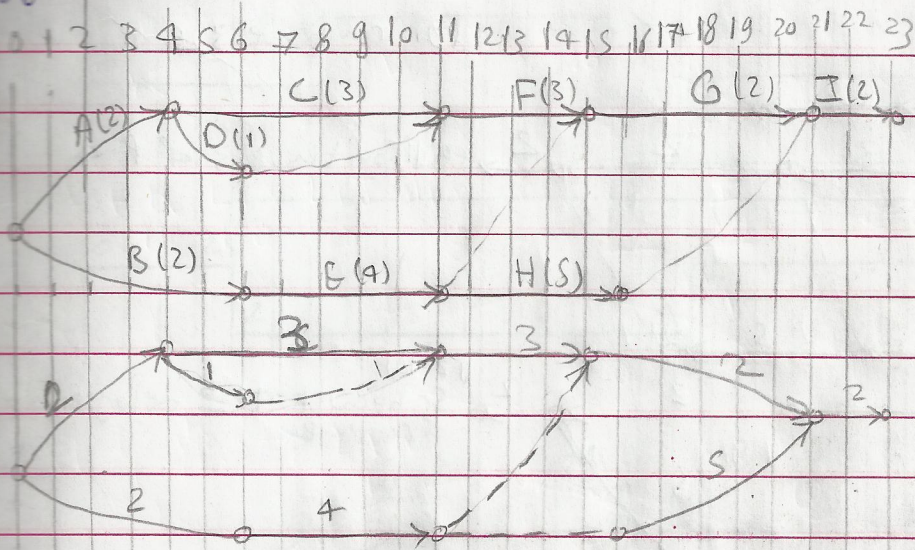




2) i.



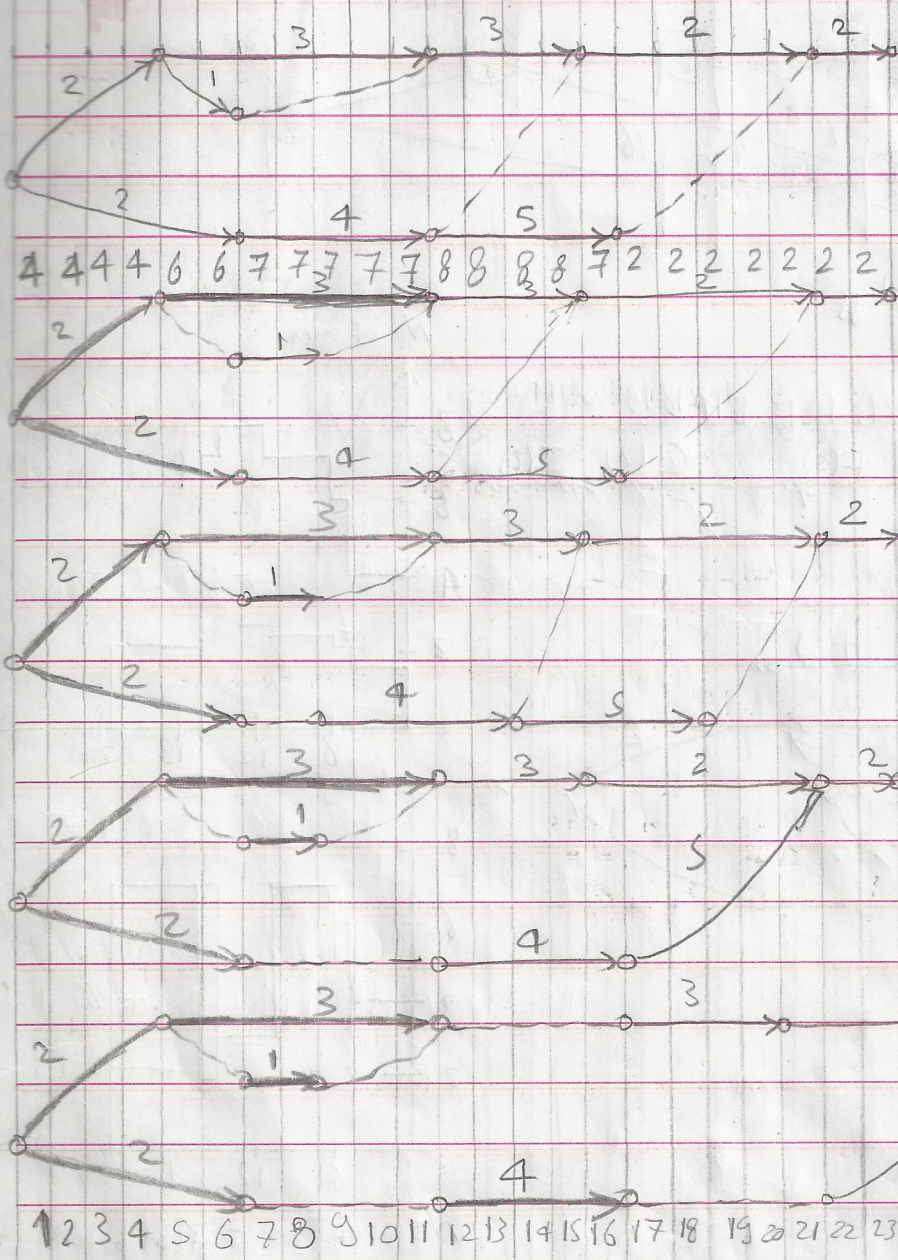
ii.



No. of men = 7 men

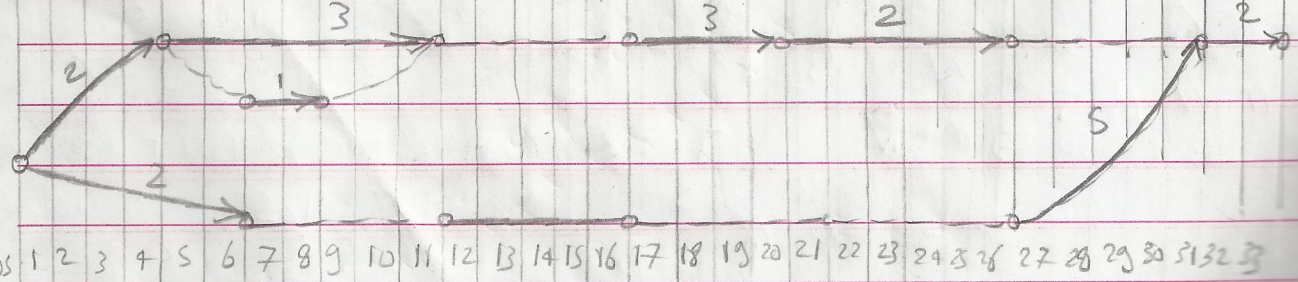


Day 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23



- Max. no. men = 5
- (1-4) Schedule 2 & 2
 - (5) Continue 2 & Schedule 3 & 1
 - (6) Continue 2 & 3 and P. 4
 - (7) Continue 3 & Schedule 1 & 1
 - (8) Continue 3 & 1
 - (9) Continue 3 & P. 4

Day 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28



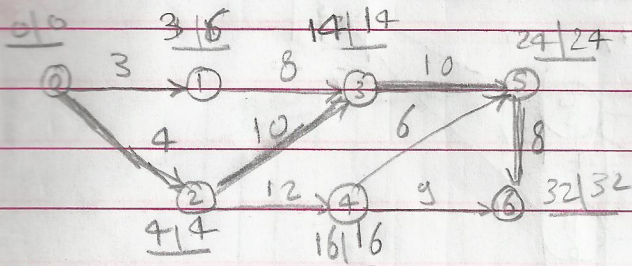
- (12-16) Schedule 4 & delay project 5 & continue
- (17-20) Schedule 3
- (21) Schedule 2
- (22) Schedule 2 & delay Project 5 & 2

Days 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33

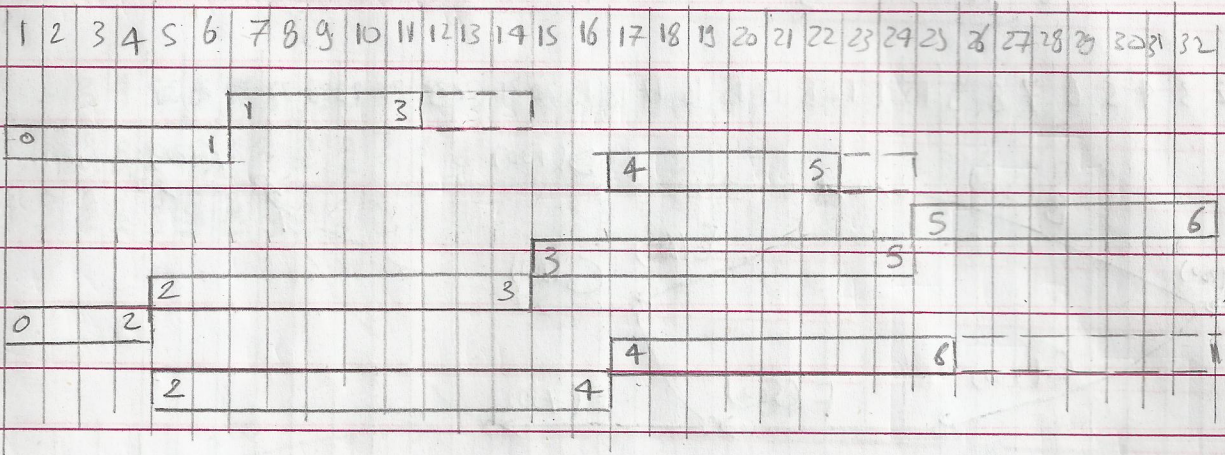


3)

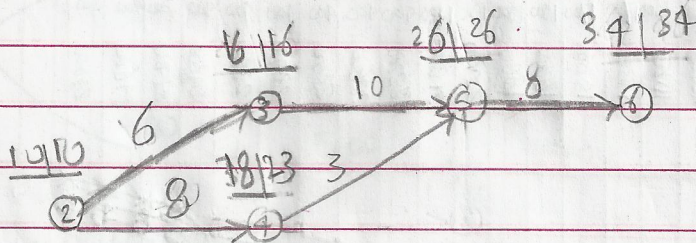
1-



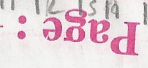
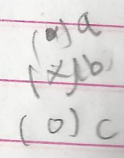
Completion time = 32 day
Critical path: 0-2-3-5-6

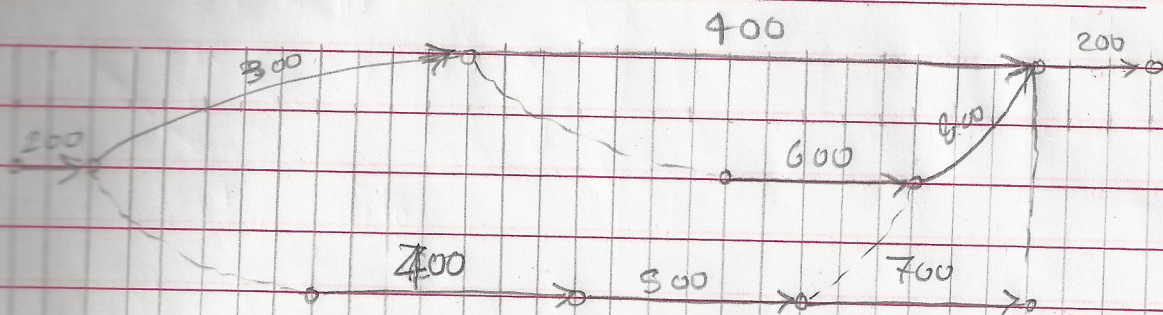


2-

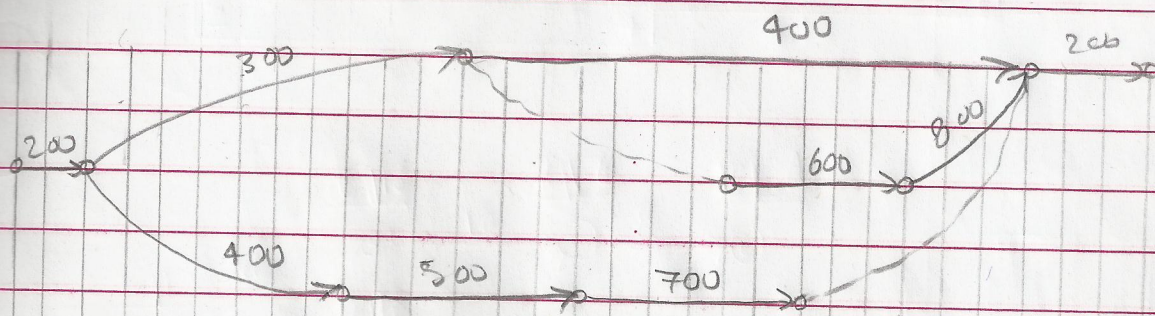


Completion time = 34 day
Effect of increase is more significant





Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Costs	200	200	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300
Acc. Costs	200	400	700	1000	1300	1600	1900	2200	2500	2800	3100	3400	3700	4000	4300	4600	4900	5200	5500	5800	6100	6400	6700	7000	7300	7600	7900	8200	8500	8800



Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Costs	200	200	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700
Acc. Costs	200	400	1100	1800	2500	3200	3900	4600	5300	6000	6700	7400	8100	8800	9500	10200	10900	11600	12300	13000	13700	14400	15100	15800	16500	17200	17900	18600	19300	20000

d - Predicted \rightarrow 6100
 Real \rightarrow 4800 [10 days]

\rightarrow It acts as it is at end of day 8

End of day 20 \rightarrow Acts as end of day 18

Acc. Costs = Acc. costs + Difference @ day 18 = 13700 + (6100 - 4800) = 15000